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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ROGER A. FRATTI and WARREN K. WASKIEWICZ

Appeal 2009-009128
Application 10/628,941
Technology Center 2800

Decided: September 28, 2009

Before CATHERINE Q. TIMM, BEVERLY A. FRANKLIN, and MICHAEL P. COLAIANNI, *Administrative Patent Judges*.

COLAIANNI, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134 the final rejection of claims 1-16. We have jurisdiction over the appeal pursuant to 35 U.S.C. § 6(b).

We AFFIRM.

Appellants disclose power transistor devices and techniques to control curvature in such devices (Spec. 1). Specifically, Appellants disclose

forming a stress compensation layer 410 atop a DMOS device 100 to affect the curvature of the device (Spec. 9; Fig. 4).

Claims 1, 7, and 10 are illustrative:

1. A method for controlling curvature of a power transistor device comprising a device film formed on a substrate, the method comprising the steps of:

thinning the substrate, the device having an overall residual stress attributable at least in part to the thinning step; and

applying a stress compensation layer to a surface of the device film, the stress compensation layer having a tensile stress sufficient to counterbalance at least a portion of the overall residual stress of the device.

7. The method of claim 1, wherein the steps of thinning and applying are performed repeatedly until a desired curvature is attained.

10. The method of claim 1, wherein the stress compensation layer applied to the surface of the device maintains the curvature of the device.

The Examiner relies on the following prior art references as evidence of unpatentability:

Oda	US 6,091,121	Jul. 18, 2000
Shibib	US 6,559,011 B1	May 6, 2003

Sergey Savastiouk, et al., *Atmospheric Downstream Plasma*, European Semiconductor 1-4 (June 1998).

Appellants appeal the following rejection:

Claims 1-16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Oda in view of Savastiouk and Shibib.

Appellants argue independent method claim 1 and device claims 13 and 16 as a group. We select claim 1 as representative of the group, with

claims 2-6, 8, 13-16 standing or falling therewith. Dependent method claims 7, 11, and 12 are argued as a group of which we select claim 7 as representative. We further address Appellants' arguments regarding separately argued dependent method claims 9 and 10.

Claim 1

ISSUE

Have Appellants shown that the Examiner reversibly erred in determining that: (1) the combined teachings of Oda, Savastiouk and Shibib teach or suggest "applying a stress compensation layer to a surface of the device film, the stress compensation layer having a tensile stress sufficient to counterbalance at least a portion of the overall residual stress of the device" as recited in claim 1 and (2) there is a reason to combine Savastiouk's thinning process with Oda? We decide these issues in the negative.

PRINCIPLES OF LAW

The applicant bears the procedural burden of showing error in the Examiner's rejections. *See, e.g., In re Kahn*, 441 F.3d 977, 985-86 (Fed. Cir. 2006) ("On appeal to the Board, an applicant can overcome a rejection [under § 103] by showing insufficient evidence of *prima facie* obviousness") (citation and internal quote omitted).

Where the claimed and prior art products are identical or substantially identical, the PTO can require an applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of the claimed product. *In re Best*, 562 F.2d 1252, 1255 (CCPA 1977).

When assessing whether a claimed invention would have been obvious, a court must ask "whether the improvement is more than the predictable use of prior art elements according to their established functions." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

Applicant's motivation does not control the obviousness analysis; rather, "any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." *KSR*, 550 U.S. at 420.

FACTUAL FINDINGS (FF)

1. Appellants do not dispute the combination of Shibib and Oda (App. Br. and Reply Br. *generally*).
2. Oda discloses a semiconductor device having layers of silicon nitride and silicon oxide atop a gate electrode to prevent moisture infiltration to the gate electrode and to control the amount of stress applied to the semiconductor structure (col. 6, ll. 34-67). Oda discloses that the stress in the layers may be tailored such that the tensile stress is relaxed by the compressive stress of another layer to prevent applying stress directly to the gate oxide film 3 and gate electrode 4 (col. 7, ll. 40-60).
3. Oda further discloses that the amount of stress applied to the semiconductor structure may be optimized by controlling the RF frequency and/or thickness of the layers (col. 6, ll. 55-67). Oda exemplifies controlling the stress in the layers so that the residual tensile stress is half of its original value (col. 8, ll. 50-57).
4. Oda discloses that the multi-layer film may include nitride (i.e., silicon nitride) and oxide (i.e., silicon oxide) layers (col. 5, ll. 60-

67, col. 6, ll. 1-19). The nitride layer has a tensile stress of 1 x 10^{10} dynes/cm^3 and the compressive stress in Oda's oxide layer is 1.5 x 10^9 dynes/cm^3, which indicates that a portion of the tensile stress of the nitride layer is necessarily available to counteract a "portion" of the residual stress of the thinned device (col. 6, ll. 34-52).

5. Savastiouk discloses that backgrinding (i.e., thinning) techniques were known in the semiconductor art and that such techniques produced residual stress that caused wafer bow and warp (Savastiouk 1).
6. The Specification defines "stress compensation layer" as including "one or more thin films or other material layers applied to a device film in order to counterbalance at least a portion of an overall residual stress of a device" (Spec. 9).
7. Appellants disclose that the stress compensation layer may be made of silicon nitrides, silicon oxides, silicon oxynitrides, oxynitrides, nitrides, and combinations thereof (Spec. 9).

ANALYSIS

Appellants argue that Oda, Savastiouk and Shibib fail to teach or suggest "applying a stress compensation layer to a surface of the device film, the stress compensation layer having a tensile stress sufficient to counterbalance at least a portion of the overall residual stress of the device" as recited by claim 1 (App. Br. 3 and 5). Appellants contend that Oda's layers 12, 15, and 17 are not disclosed as providing a tensile stress sufficient to counterbalance any amount of overall residual stress from the substrate thinning (App. Br. 5). Appellants also contend that Oda discloses that the

layers in the multi-layer film merely compensate for stresses inherent in layers adjacent to the multi-layer film (App. Br. 5).

The Examiner finds that Oda discloses forming a multi-layer film made of the same materials disclosed by Appellants, such that it would be an inherent property of the material to provide a tensile stress sufficient to counterbalance at least a portion of the residual stress in a thinned substrate (Ans. 6). This finding by the Examiner properly shifted the burden to Appellants to establish that the prior art does not possess the particular characteristic (i.e., counterbalancing a portion of the residual stress of the device). *Best*, 562 F.2d at 1255.

Appellants respond by stating that even though the film may inherently have a tensile stress, it does not necessarily have a tensile stress sufficient to counterbalance at least a portion of an overall residual stress of the device (Reply Br. 4). However, Appellants have not shown error in the Examiner's determination that Oda's film would inherently have a residual stress sufficient to balance at least "a portion" of the residual stress caused by a thinning operation taught by Savastiouk. Indeed, the example relied upon by the Examiner (col. 6, ll. 44-45; Ans. 6) shows that the tensile stress in Oda's nitride layer is 1×10^{10} dynes/cm^3 and the compressive stress in Oda's oxide layer is 1.5×10^9 dynes/cm^3, which indicates that a portion of the tensile stress of the nitride layer is necessarily available to counteract a "portion" of the residual stress of the thinned device as claimed.

Appellants further argue that there is no motivation to combine Savastiouk's thinning process with Oda because Savastiouk does not disclose or suggest that "thinner wafers may be used to control curvature of a power transistor device, as taught by the present invention" (App. Br. 4).

Appellants' argument improperly requires the Examiner's reason for combining the prior art references to be the same as Appellants' reason. To the contrary, any need or problem known in the field of endeavor can provide a reason for combining the elements in the manner claimed. *KSR*, 550 U.S. at 420

Appellants' motivation argument fails to show reversible error in the Examiner's stated reason for combining Savastiouk's thinning process with Oda's semiconductor manufacturing method: to adapt the device to current technology and to increase the number of chips per wafer (Ans. 4).

Claim 7

ISSUE

Have Appellants shown reversible error in the Examiner's determination that it would have been obvious to repeat the steps of thinning and applying stress compensation layers until a desired curvature is attained as recited in claim 7? We decide this issue in the negative.

PRINCIPLES OF LAW

In addition to the principles of law noted above, we rely on the following principles:

The test for obviousness is what the combined teachings of the references would have suggested to one of ordinary skill in the art. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

The obviousness "analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court

can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR*, 550 U.S. at 417-18.

ADDITIONAL FINDINGS OF FACT

8. The Examiner stated that the subject matter of claim 7 would have been obvious over the combined teachings of Oda, Shibib and Savastiouk "in order to have better control over the characteristics of the device and by using known monitoring techniques" (Ans. 5).

ANALYSIS

Appellants argue that none of the prior art teaches repeatedly performing the thinning and applying steps until a desired curvature is obtained (Reply Br. 5). Appellants contend that the prior art fails to disclose that thinning of the substrate would produce a curvature of the device (App. Br. 5).

Appellants' argument that the prior art does not teach that thinning produces curvature is unpersuasive because, as the Examiner points out, Savastiouk teaches that thinning the substrate produces residual stress that causes wafer bow and warp (Ans. 9; FF 5). Accordingly, combining Savastiouk's thinning technique with Oda's semiconductor process would have produced a thinner semiconductor substrate having residual stress. As noted above, Oda exemplifies an embodiment where the tensile stress of the nitride layer is greater than the compressive stress of the oxide layer thereby counterbalancing a portion of the residual stress inherent in the thinned wafer of the Oda and Savastiouk combination.

Appellants' argument that the art does not teach the "repeated" feature of claim 7, fails to show error in the Examiner's determination that one of ordinary skill would have known to monitor and repeat the thinning and stress compensation layer applying steps to have better control over the characteristics of the device (Ans. 5). In fact, Appellants contend that the Examiner's determination is "incorrect" based on Appellants' argument that the cited references do not disclose that thinning the substrate would produce a curvature (App. Br. 5). This argument was shown above to be factually erroneous.

That none of the cited art, individually, expressly teaches repeated thinning and applying steps is of no moment because the Examiner may take account of inferences and creative steps that a person of ordinary skill would employ. *KSR*, 550 U.S. at 417-18. The Examiner's analysis takes account of the inferences and creative steps (i.e., monitoring and repeated application) that would have been employed by one of ordinary skill, which Appellants have not shown to be in error.

Indeed, Oda discloses that it was known to optimize the stress in the film by controlling the RF frequency during deposition and/or the layer thickness of multiple layers (i.e., repeated depositions). Therefore, it would have been obvious to thin the substrate as taught by Savastiouk and apply layers of material as taught by Oda to optimize the desired stress and thus curvature of the device. The thinning process is taught by Savastiouk as introducing residual stress into the device that may cause the device to bow or warp. Oda teaches controlling the stress in the multi-layer film to counteract stresses in various layers of the device. Accordingly, the

combined teachings of the references would have suggested the invention of claim 7.

In fact, Appellants' arguments that "Oda, Savastiouk, *or* Shibib" (emphasis added) fail to disclose the claim 7 subject matter indicates that Appellants improperly attack the references individually, instead of addressing what the combined teachings would have suggested to one of ordinary skill the art. *Keller*, 642 F.2d at 425.

Accordingly, Appellants have not shown that the Examiner reversibly erred in determining that it would have been obvious to repeat the steps of thinning and applying stress compensation layers until a desired curvature is attained as recited in claim 7.

Claims 9 and 10

ISSUE

Have Appellants shown that the Examiner reversibly erred in determining that Oda's nitride layer (i.e., stress compensation layer) would have inherently changed (claim 9) or maintained (claim 10) the curvature of a power transistor device as claimed? We decide this issue in the negative.

PRINCIPLES OF LAW

We rely on the principles of law noted earlier in this Decision.

FINDINGS OF FACT

9. The Examiner determines that Oda's nitride film inherently has a tensile stress such that applying the nitride film to a thinned semiconductor device as taught by Savastiouk would have

inherently affected (changed or maintained) the curvature of the device (Ans. 5 & 9).

10. Claims 9 and 10 depend from claim 1, which recites that "the stress compensation layer [has] a tensile stress sufficient to counterbalance at least a portion of the overall residual stress of the device" (claim 1).

ANALYSIS

Appellants argue that there is no suggestion in Oda that a stress compensation layer applied to the surface of the device changes or maintains the curvature of the device (App. Br. 6). Appellants contend that Oda merely discloses a protecting insulator film having a compressive stress for relaxing a tensile stress of the protecting nitride film (App. Br. 6).

While Oda does disclose that the oxide film relaxes the nitride film (col. 7, ll. 50-53), Oda further exemplifies that the tensile stress is not necessarily eliminated (FF. 4). Accordingly, a portion of the tensile stress would still be present and inherently change or maintain the curvature of the thinned substrate by affecting a portion of the residual stress as required by claim 9.

Accordingly, Appellants have not shown reversible error with the Examiner's determination that Oda's layers would inherently affect (change or maintain) the curvature of the device.

Moreover, Oda discloses that the stress in the various layers can be optimized by controlling the RF frequency during deposition and/or thickness of the layer (FF 3). In fact, Oda exemplifies that the stress in the various layers may be optimized to a desired value, which may include halving the tensile stress of the nitride layer (FF 3). Therefore, it would

have been obvious to optimize the stress in the multilayer film to any desired level.

The desired level of stress would have included optimizing the stress level to counterbalance the stress caused by the thinned substrate and the tensile stress in the nitride layer. When the stress in the nitride layer is optimized to completely counterbalance the tensile stress in the nitride layer, the multilayer would maintain the curvature of the thinned substrate (i.e., it would have no affect on the curvature).

Similarly, when the tensile stress of the nitride layer is optimized to only partially counterbalance the tensile stress in the nitride layer, as in Oda's example (FF 3), then a portion of the tensile stress would be available to counterbalance the residual stress in a thinned substrate and thereby change the curvature of the device to some extent.

For the above reasons, we affirm the Examiner's § 103 rejection of claims 9 and 10 over Oda in view of Savastiouk and Shibib.

DECISION

We affirm the Examiner's § 103 rejection of claims 1-16 over Oda in view of Savastiouk and Shibib.

ORDER

The Examiner's decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1).

AFFIRMED

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